# DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

# NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

| COURSE OUTLINE | | | |
|---|---|---|---|
| **Course Title** | **DC MACHINES AND TRANSFORMERS** | | |
| **Course Code** | **EEPC12** | **No. of Credits** | **04** |
| **Department** | **ELECTRICAL AND ELECTRONICS** | **Faculty** | **Dr. P. RAJA** |
| **Pre-requisites Course Code** | **NIL** | | |
| **Course Coordinator(s) (if, applicable)** | **Not Applicable** | | |
| **Other Course Teacher(s)/Tutor(s) E-mail** | dcmctrans@gmail.com | **Telephone No.** | **0431-250 3264 9942680653** |
| **Course Type** | ☑ **Core course** ☐ **Elective course** | | |

## COURSE OVERVIEW

An Electrical Machine is an electro-mechanical energy converter. It is a device that converts either mechanical energy to electrical energy - *generator* or electrical energy to mechnaical energy - *motor*. An electrical machine is a dual machine and hence each machine can be used as either generator or a motor. Almost all practical electical machines convert energy from one form to another through the action of a magnetic field. Electrical machines provide green energy production and hence insight into such machines, their design and working principles become inevitable for an electrical engineer. Only machines using magnetic fields as medium of energy conversions are considered in this course.

The *transfomer* is an electrical device that transfoms AC electrical energy at one voltage level to another voltage level, operated at same frequency. Since transformers also operate on the principle of electromagnetic induction, similar to generators and motors, depending on the action of magnetic filed to accomplish the change in voltage level, they are usually studied together with electrical machines. Morevover transformers play a major role in power transfer in large power systems. Hence transformers are also taught along with the electrical machines.

These three types of electric devices are ubiquitous in modern daily life. Electric motors are used widely in the home run refrigerators, freezers, vacuum cleaners, blenders, air conditioners, fans and many similar appliances. In the workplace, motors provide the motive power for all tools. Of course, generators are necessary to supply the power used by all these motors. Hence as an Electrical Engineer, it is essential to know the operating characteristics and relevant performace parameters of above said electrical machines.

In this course, the discussion is limited to Direct Current operated electrical machines(motors and generators). Prior to studying about various electro-mechanical systems, it is indispensable to understand about the basics of magnetic circuits and its relevant parameters.

**COURSE OBJECTIVES**

To expose the students to the basic concepts of various types of electrical machines such as DC Machines and Transformers and their applications. The students will be exposed to the relevant performance characteristics and their control techniques of such electrical machines.

**COURSE OUTCOMES (CO)**

| **Course Outcomes** | **Aligned Programme Outcomes (PO)** |
|---|---|
| Upon completion of the course the students would be able to | |
| 1. Understand the constructional details and principle of operation of DC machines and Transformers | **2, 7, 9, 10,12** |
| 2. Analyze the performance of DC machines under various operating conditions using their characteristics | **2, 7, 8, 9, 10, 12** |
| 3. Evaluate the performance of the transformers using phasor and equivalent circuit | **2, 7, 8, 9, 10, 12** |
| 4. Select an appropriate DC motor as well as to choose appropriate method of speed control for any industrial applications | **2, 7, 5, 8, 9, 10, 12** |

**COURSE TEACHING AND LEARNING ACTIVITIES**

| **S.No.** | **Week** | **Topic** | **Mode of Delivery** |
|---|---|---|---|
| 1 | 2nd Week of July (10th to 14th July) (**4 Contact Hours)** | Course plan details<br>General introduction<br>Basics of Electro-mechanical conversion | Lecture<br>PPT and<br>C&T |
| 2 | 3rd Week of July (17th to 21st July) **(4 Contact Hours)** | Magnetic circuit analysis<br>Singly and doubly excited magnetic field system | Lecture C&T |
| 3 | 4th Week of July (24th to 28th July) **(4 Contact Hours)** | General Torque equation for Electrical Machines<br>Introduction and Principle of Electric Generator | Lecture C&T |
| 4 | 1st Week of August (31st July to 4th August) **(4 Contact Hours)** | Construction and types of DC generators<br>***QUIZ I – Assessment 1*** | Lecture C&T<br>PPT |
| 5 | 2nd Week of August (7th to 11th August) **(4 Contact Hours)** | Characteristics of DC generators and Commutation | Lecture C&T |
| 6 | 3rd Week of August (14th to 18th August) **(3 Contact Hours)** | Armature reaction<br>Principle of operation of DC Motor | Lecture C&T<br>**PPT**<br>**Video** |
| 7 | 4th Week of August (21st to 25th August) **(4 Contact Hours)** | Torque expression and Types of DC Motor<br>***QUIZ II – Assessment 2*** | Lecture<br>C&T |

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|---|---|---|---|
| 8 | 5th Week of August (28th August to 1st Sep.)<br><br>**(4 Contact Hours)** | Types and Electrical and Mechanical characteristics of DC Motors | Lecture C&T |
| 9 | 1st Week of Sep. (4th to 8th Sep)<br>**(4 Contact Hours)** | Starting, Speed control and Testing techniques for DC Motors<br>***QUIZ III – Assessment 3*** | Lecture C&T |
| 10 | 2nd Week of Sep. (11th to 15th Sep.)<br><br>**(4 Contact Hours)** | Braking techniques for DC Motor<br>Principle of operation of Transformer<br>Emf equation and types (under no-load and loading conditions) along with phasor | Lecture C&T<br>Video |
| 11 | 3rd Week of Sep. (18th to 22nd Sep.)<br><br>**(2 Contact Hours)** | Emf equation and types (under no-load and loading conditions) along with phasor | Lecture C&T |
| 12 | 4th Week of Sep. (25th to 29th Sep.)<br><br>**(2 Contact Hours)** | Equivalent circuit of transformer | Lecture C&T |
| 13 | 1st Week of October (2nd to 6th Oct.)<br><br>**(4 Contact Hours)** | Equivalent circuit of transformer<br>Testing of transformers<br><br>***Numerical Test – Assessment 4*** | Lecture C&T |
| 14 | 2nd Week of October (9th to 13th Oct)<br><br>**(4 Contact Hours)** | Auto transformer and Three-phase transformers (connections) | Lecture C&T<br>PPT |
| 15 | 3rd Week of October (16th to 20th Oct)<br>**(2 Contact Hours)** | All day efficiency | Lecture C&T |
| 16 | 4th Week of October (23rd to 27th Oct)<br>**(2 Contact Hours)** | Sumpner's test | Lecture C&T |
| 17 | 5th Week of October (30th Oct. to 3rd Nov.)<br>**(4 Contact Hours)** | Parallel operation of transformers<br>*And any left out topics* | Lecture C&T<br>PPT |
| 18 | 2nd Week of Nov.<br><br>(13 to 17th Nov.) | ***ASSESSMENT – 6*** | Descriptive Written Exam |

**C&T : Chalk and Talk**
**PPT : Power Point**
**All 4 contact hours include Tutorial Class.**

**COURSE ASSESSMENT METHODS**

| Assessment .No. | Mode of Assessment | Week/Date | Duration | % Weightage |
|---|---|---|---|---|
| 1 | Quiz I | 1st Week of August | 30 Minutes | 10 |
| 2 | Quiz II | 4th Week of August | 30 Minutes | 10 |
| 3 | Quiz III | 1st Week of September | 30 Minutes | 10 |
| 4 | Numerical Problems / Written Test | 1st Week of October | 60 Minutes | 20 |
| 5 | Surprise test | -- | 10 Minutes | 10 |
| CPA | Compensation Assessment (Written Test) | 3rd Week of October | 60 Minutes | Maximum of 20 |
| 6 | Descriptive Type Examination | 2nd Week of November | 120 Minutes | 40 |

**ESSENTIAL READINGS : Textbooks, Reference Books Website addresses, journals, etc.**


1. Dr. P.S. Bhimbra, 'Electrical Machinery', Khanna Publications, 7th Edition, 2007.
2. Nagrath, I.J. and Kothari, D.P., 'Electrical Machines', Tata McGraw-Hill Education Private Limited Publishing Company Ltd., 4th Edition, 2010.
3. A.E. Fitzgerald and Charles Kingsley, 'Electric Machinery', Tata McGraw-Hill Education Publications, 6th Edition, 2002.
4. Vincent Del Toro, 'Electrical Engineering Fundamentals', 2nd Edition, Prentice Hall Publications, 2003.
5. Parker Smith, N.N., 'Parker Smith's Problems in Electrical Engineering', 9th Edition, CBS Publishers and Distributers, 9 th Edition, 2003.


**COURSE EXIT SURVEY (mention the ways in which the feedback about the course is assessed and indicate the attainment also)**

- Feedback from the students during class committee meetings
- Anonymous feedback through questionnaire (Mid of the semester & End of the semester)
- End semester feedback on Course Outcomes

**COURSE POLICY (including plagiarism, academic honesty, attendance, etc.)**

**CORRESPONDENCE**

1. All the students are advised to check their NITT WEBMAIL regularly. All the correspondence (schedule of classes/ schedule of assessment/ course material/ any other information regarding this course) will be done through their webmail only.

2. Queries (if required) to the course teacher shall only be emailed to dcmctrans@gmail.com

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### ATTENDANCE

1. Attendance will be taken by the faculty in all the contact hours. All the students are expected to attend all the contact hours.

2. **Every student should maintain minimum 75 % attendance in these contact hours.**

3. Any student, who fails to maintain 75% attendance need to score more than 50% marks in the assessments 1to5 (in total) for attending the final assessment. Students fail to satisfy this criteria will have to REDO the course.

### ACADEMIC HONESTY & PLAGIARISM

1. All the students are expected to be genuine during the course work. Taking of information by means of copying simulations, assignments, looking or attempting to look at another student's paper or bringing and using study material in any form (paper, mobile phone etc.,) for copying during any assessments is considered dishonest.

2. Tendering of information such as giving one's program, simulation work, assignments to another student to use or copy is also considered dishonest.

3. Preventing or hampering other students from pursuing their academic activities is also considered as academic dishonesty.

4. **Any evidence of such academic dishonesty will result in the loss of marks on that assessment.** Additionally, the names of those students so penalized will be reported to the class committee chairperson and HoD of the concerned department.

## ADDITIONAL COURSE INFORMATION

**The faculty is available for consultation at times as per the intimation given by the faculty. Queries may also be emailed to the Course Coordinator directly at eeacmachines@gmail.com**

**For Approval**

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|---|---|---|
| M. VENKATAKIRTHIGA. | Dr. S. ARUL DANIEL | 10/07/2017 |
| **Course Faculty** | **CC-Chairperson** | **HoD/EEE** |

PROF/EEE/NITT.